

## 3.4 Problem Solving

## Ex 1 Factored form

The height of a rocket is given by the function

$$h(t) = -4.9(t+2)(t-5)$$

where  $h(t)$  is the height in meters and  $t$  is the time in seconds.

Which do I answer first?

- c) Determine when the rocket should hit the ground.

$$= -4.9(t+2)(t-5)$$

$t = -2$   $t = 5$   
 Reject  $t = 5$   
 The rocket hits the ground after 5 seconds.

- b) When does the rocket reach the maximum height?

$$AOS = \frac{-2+5}{2} = 1.5$$

∴ the rocket reaches its maximum height after 1.5 seconds

- a) What is the maximum height of the rocket?

Sub  $t = 1.5$  into equation

$$= -4.9(t+2)(t-5)$$

$$= -4.9(1.5+2)(1.5-5)$$

$$= 60.025$$

∴ the maximum height of the rocket is 60.025 m.

- d) What was the initial height of the rocket?

Set  $t = 0$

$$= -4.9(0+2)(0-5)$$

$$= 49$$

∴ the initial height of the rocket is 49 m.

- e) State the domain and range as it applies to the situation.

$$D = \{t / 0 \leq t \leq 5, t \in \mathbb{R}\}$$

$$R = \{h(t) / 0 \leq h(t) \leq 60.025, h(t) \in \mathbb{R}\}$$

## Ex 2 Vertex form

The height of a football that has been thrown is modelled by the equation:  $h(t) = -4(t-2)^2 + 17$  where  $h(t)$  is the height in meters and  $t$  is in seconds.

Which do I answer first?

- a) What is the maximum height of the ball?

∴ the max height of the ball is 17m

- c) When does the ball reach the maximum height?

∴ the ball reaches the max height after 2 seconds

- b) What was the initial height of the ball?

Set  $t = 0$   $h(t) = -4(0-2)^2 + 17$

$$= -4(4) + 17 = 1$$

∴ the initial height of the ball is 1m.

- d) Determine when the ball should hit the ground.

Set  $h(t) = 0$   $h(t) = -4(t-2)^2 + 17$

$$0 = -4(t-2)^2 + 17$$

$$-17 = -4(t-2)^2$$

$$\frac{-17}{-4} = \frac{-4(t-2)^2}{-4}$$

$$4.25 = (t-2)^2$$

$$\pm 2.06 = t - 2$$

$$t = 2 + 2.06 \text{ or } t = 2 - 2.06$$

$$t = 4.06 \text{ or } t = -0.06 \text{ reject}$$

- e) State the domain and range as it applies to the situation.

Do  $5 \leq t \leq 4.06$ , reject

$$R = \{h(t) / 0 \leq h(t) \leq 17, h(t) \in \mathbb{R}\}$$

For how long will the ball be at or above a height of 9 m?

$$9 = -4(t-2)^2 + 17$$

$$9 - 17 = -4(t-2)^2$$

$$-8 = -4(t-2)^2$$

$$\frac{-8}{-4} = \frac{-4(t-2)^2}{-4}$$

$$2 = (t-2)^2$$

$$\pm 1.41 = t - 2$$

$$2 \pm 1.41 = t$$

$$t_1 = 0.59$$

$$= 3.41 - 0.59$$

$$= 2.82$$

∴ the ball will be above 9m for 2.82 seconds